

Rake and Trail

The concepts of rake and trail are some of the most important factors when determining the handling of a motorcycle or trike. We often get questions such as: how is rake and trail measured? How do they affect one another? Is the optimal rake and trail different if I convert my bike to a trike? Well, to understand these concepts fully we have to first understand how it's all measured.

To put it simply, rake is how much the neck, or steering axis, is angled from true vertical. On many stock motorcycles fork tube angle and neck rake are the same, but not always so it's important to measure from the neck to the ground.

Rake angle is measured counter-clockwise from a vertical line while looking at a bike or trike from the right side. If you had zero degrees of rake, an extreme and dangerous example, your front end would be directly above your front axle. On a sport bike, the rake might be 26° , whereas a long chopper's rake would be more like 45° .

To measure trail, make a straight line down from the center of the front wheel's axle to the contact point and another line following the steering axis (drawn along the center-line of the neck), both extending to the ground. Trail is the distance between where the steering axis line meets the ground and contact point of the front tire. The length of the distance between the two points where the lines meet the ground is the trail. On a two-wheeled motorcycle, the desired amount of trail is typically between 3.5" and 6".

This measurement is actually called "false trail," but it's what is typically used by anyone who isn't an engineer. But if you want to impress your friends, tell them that you know about "mechanical trail." True mechanical trail is still measured from the front axle contact point to the rake angle line, but is drawn perpendicular to the rake angle.

Rake and trail are measurements built into a bike or trike's front end that allow it to track straight and steer predictably. Generally, the more trail that you have, the more stability you'll get at high speeds while with less trail, the more maneuverability at low speeds. But both have their drawback: bikes or trikes with more trail have less turning ability at low speeds (imagine doing a three-point turn on a chopper), but ones with less trail can develop a dangerous wobble at high speeds.

The simplest explanation of the effect that rake and trail have on handling can be explained by imagining a castor wheel on the front of a shopping cart. The front wheel has a castor with a vertical steering axis in front of the wheel. Because the steering axis is vertical, the wheel has no rake and because the wheel is behind the steering axis, it has a great deal of trail. Whichever direction the cart is pushed in, the wheel will track directly behind the pivot.

If the steering axis were directly above the wheel, it would have no directional stability and would go left or right just as easily as it would go straight, which would be just as unsuitable for a shopping cart as it would be for a motorcycle or trike. An important concept to tie in with this is the "castor effect." As the wheel rolls forward, the contact patch of the tire naturally trails behind, following the direction of movement.

There is no formula to find the perfect amount of trail, it varies with your type of motorcycle or trike and with what you are looking for in a ride.

There are several different ways to make adjustments to the trail of your ride. However, one thing to keep in mind is that any time you adjust the rake, trail is affected. When you increase your rake, you also increase your trail and vice-versa. Also note that any change, even minor ones, can result in a change in trail.

To **increase** trail you can:

- increase the neck rake
- decrease the triple tree rake
- increase the size of the front wheel (which increases neck rake)
- install longer fork tubes (which increases neck rake)
- lower the bike or trike in the rear only

To **decrease** trail you can:

- decrease the neck rake
- increase the triple tree rake
- decrease the size of the front wheel (which decreases neck rake)
- decrease fork tube length (which decreases neck rake)
- raise the bike or trike in the rear only
- lower the bike or trike in the front only

An example of successfully altering trail can be even be seen in stock motorcycles. The 1980 Harley-Davidson FXS Lowrider had straight triple trees with no rake and a 19" front tire. The same year, Harley-Davidson released an FXWG Wideglide, that had the exact same frame, but with 4" longer fork tubes and a 21" front wheel. The longer forks and bigger front tire increased trail so, to compensate, Harley-Davidson equipped this model with a 3° raked triple tree.

Frankenstein Trike's new line of raked triple tree kits is the simple and effective solution to make your trike easier to steer.

When riding a two-wheeler, the rider leans into turns to counteract the effect of inertia (inertia makes the motorcycle want to go straight forward). But with a trike, leaning won't get you very far and trying to steer a trike with a significant amount of trail can be exhausting on the rider. The solution to this problem was to decrease trail, giving the rider a mechanical advantage when turning. Also ideal for a bike with a larger front wheel or a bike with a sidecar, Frankenstein Trikes offers raked triple trees for most Harley-Davidson models.